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Dorset Environmental Science Centre: Lake Sampling Methods

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Dorset Environmental Science Centre: Lake Sampling Methods

Report prepared by:
Ingram, R.G.(1), Girard, R.E.(1), Clark, B.J.(1), Paterson, A.M.(1), Reid, R.A.(1), Findeis, J.G.(2)

(1) Ontario Ministry of the Environment, Dorset Environmental Science Centre, 1026 Bellwood Acres Road,
Dorset, ON, P0A 1E0
(2) Environmental and Resources Studies, Trent University, 1600 West Bank Drive, Peterborough, ON, K9J 7B8

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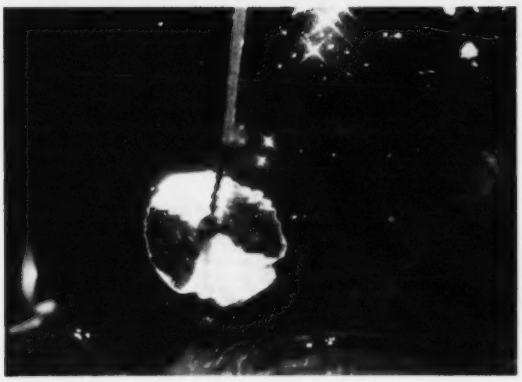
Lake Sampling Methods



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INTRODUCTION

Over the last several years, changes have been made to the sampling methods used by staff at the Ontario Ministry of the Environment's (MOE) Dorset Environmental Science Centre (DESC) for the collection of lake water for chemical and biological analysis. To ensure the use of consistent methodology by all lake samplers at DESC (MOE and partners), routines for the preparation, calibration, sampling and submission of samples should be clearly documented.

The purpose of this document is to guide samplers through the DESC lake sampling routines, thus ensuring the use of consistent methods. This guide focuses on field sampling methods currently in use at DESC, and does not give a historical account of sampling protocols, nor provide protocols for data collection, data handling, or statistical analyses. For a more in-depth review of sampling methodologies used historically at DESC, please consult the "History of Chemical, Physical and Biological Sampling Methods, Sampling Locations and Lake Morphometry for the Dorset Environmental Science Centre (1973 - 2003)" (Girard et al., In Press).

This guide outlines the following:

- calibration procedures for field instruments and equipment
- sampling routines for thermally-mixed and stratified lakes
- protocol for obtaining zooplankton and *Bythotrephes longimanus* hauls
- information on sampling lakes with invasive species
- health and safety protocols
- sampling submission procedure
- a field checklist

The document also includes images of field equipment, calibration tables, recipes for preservatives, examples of submission forms, volume-weighting charts and the "Sample Submission to MOE and Trent Labs at the Dorset Environmental Science Centre" guide.

BACKGROUND

Intensive lake sampling at the Dorset Environmental Science Centre (formerly Dorset Research Centre) began in 1976. Historically, lakes were categorized as "A", "B" or "C" lakes. "A" lakes refer to those with calibrated watersheds selected to span a gradient of shoreline development. "A" lakes were sampled weekly from 1976 to 1982, and bi-weekly from 1982 to 1985. Sampling frequency has been variable since the mid-1980s, although the "A" lakes are monitored at least monthly during the ice-free season. "B" lakes, initially selected as a test set for the Lakeshore Capacity Model, were sampled on a monthly basis during the ice-free season from 1976 to 1989, and in the spring during the 1990s. These lakes do not have calibrated watersheds. The "C" lakes refer to other lakes sampled at irregular intervals or as part of short-term projects.

Over the years, the sampling frequency for the "A" and "B" lakes has varied. Currently, the MOE samples ten "A" lakes on a monthly basis during the ice-free season (Appendix 4). Three of these (Dickie, Harp and Plastic Lakes) are sampled bi-weekly. The remaining lakes (the "B" lakes) are sampled once a year during the spring overturn period and for end-of-summer oxygen in early September. There are 27 lakes in this category (Appendix 4).

The methods outlined in this document are designed for small headwater lakes with relatively simple basins. Our current long-term data set consists of 36 single or two-basin lakes that are <130 ha in surface area.

I. FIELD SAMPLING PREPARATION

Obtaining good quality samples begins in the lab with careful calibration of instruments, ropes and hoses.

(A) Ropes and hoses

Ropes and hoses should be metered while being held taut. A mark is made at each metre using a high-quality permanent marker. Five metre intervals should be clearly marked. Good quality ¼" or 3/16" braided polyester, low stretch rope, and 3/8" I.D. Tygon tubing should be used.

(B) Oxygen Meters

Analog-type oxygen/temperature meters (e.g. YSI model 58) should be calibrated in one of the following two ways:

Method 1: Air-saturated water (preferred method)

1. Turn the meter on and allow it to stabilize for 15 – 20 minutes. It is important that temperature be held constant.
2. Place the probe in air-saturated (using an aquarium aerator) distilled water at room temperature.
3. The function switch is turned to the ZERO mode and the readout adjusted to 0.00.
4. The function switch is turned to the 0.01mg/L O_2 mode.
5. On the back of the meter (or in the manual) are charts that provide calibration information. From the temperature chart choose the O_2 value that coincides with the water temperature. Then from the altitude chart choose the calibration value that coincides with the local altitude (Muskoka is about 1000 feet above sea level).
6. Multiply the two numbers together to determine the correct O_2 reading. For example if the water temperature is 20°C, the coinciding O_2 reading is 9.07mg/L. The calibration value is 96.Therefore (9.07 x 96) /100 = 8.71mg/L.
7. Unlock the O_2 calibration knob and adjust the O_2 readout to 8.71.
8. Relock the O_2 calibration knob.

Method 2: Air calibration

1. Turn on the meter and allow it to stabilize for 15 – 20 minutes. Again, temperature should be constant.
2. Ensure the sponge in the plastic probe cover is moist.
3. The function switch is turned to the ZERO mode and the readout adjusted to 0.00.
4. Move the function switch to the % mode, unlock the O_2 calibration knob and adjust the readout to read the calibration value for the local altitude.
5. Relock the O_2 calibration knob.

The probe membrane (Figures 1 and 2) should be changed monthly or at any time the meter appears to have trouble holding calibration. To change the membrane, remove the guard, pull off the o-ring and old membrane, and shake the solution out of the probe. Cut a new membrane and

add fresh O_2 probe solution while gently depressing the rubber diaphragm on the side of the probe to remove all bubbles. Carefully place the membrane on the probe while ensuring no bubbles are present and pull the o-ring back into position over the membrane. Replace guard (Figures 1 and 2).

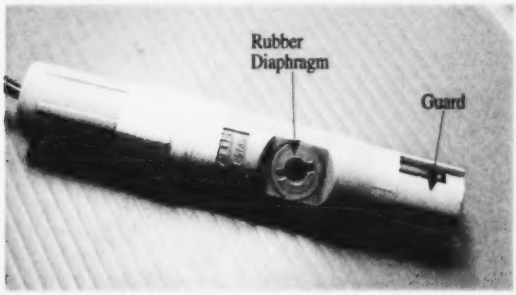

Figure 1.
O_2 probe

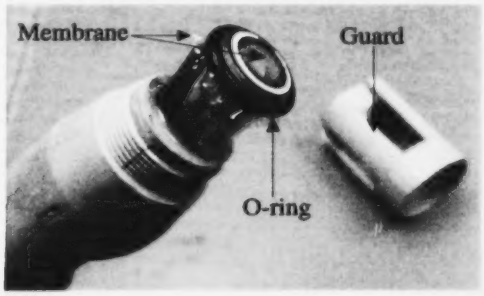

Figure 2.
O_2 probe with guard removed showing o-ring and membrane

Digital oxygen/temperature meters (e.g., YSI model 95) are calibrated as follows:

1. Ensure that the sponge in the probe cover is wet.
2. Turn the instrument on and allow it to stabilize for 15 minutes.
3. Press the up and down keys simultaneously.
4. Adjust for altitude and press enter.
5. The instrument will show the current oxygen reading and the calibration value (corrected for altitude). To accept these readings press enter. To reject, press the mode key and the unit will revert to the last calibration values.

To change the membrane, simply screw off the old tip, add fresh O_2 probe solution, and screw one of the preprepared tips onto the end of the probe while being careful to avoid bubbles.

(C) Light Meter
The Li 1400 light meter should be returned to the manufacturer every second year for calibration (the sensors will be calibrated in the winter of 2004-05). The meter can be checked on a monthly basis for calibration by exposing the down-welling and reference sensors to a constant light source while blocking all light from the up-welling sensor. The reference and down-welling readings should be identical.

(D) Miscellaneous
Always ensure that the 12 volt battery (powers the peristaltic pump) is charged (Appendix 1). If not, charge the battery for a full work day. Remove from charger before leaving at day's end. Before departure, check: the trailer and its lights, the boat plug, and the gas for the outboard motor (Two stroke outboards typically use a 50:1 gas to oil mixture. Four stroke outboards use straight gas as they have a built in oil reservoir and should always be transported in an upright position - oil will leak out of the motor when in a prone position).

add fresh O_2 probe solution while gently depressing the rubber diaphragm on the side of the probe to remove all bubbles. Carefully place the membrane on the probe while ensuring no bubbles are present and pull the o-ring back into position over the membrane. Replace guard (Figures 1 and 2).

Figure 1.
O_2 probe

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O_2 probe with guard removed showing o-ring and membrane

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II. LAKE SAMPLE COLLECTION METHODS

(A) Sampling Protocols for Different Lake Sets

Spring-turnover whole-lake chemistry sampling is started about one week following ice-out (to allow lakes to mix), and is completed while the lakes are mixed (temperature and water chemistry is theoretically consistent throughout the lake). Spring sampling includes a measure of Secchi disk depth, oxygen/temperature profiles, a light reading and a whole-lake (composite) water sample (Table 1).

Please note that whole-lake composite samples for the "A" lakes (Appendix 4) are obtained using a peristaltic pump and weighted hose. Volume-weighted charts are required to determine water volumes. Spring sampling includes the collection of water samples for phytoplankton and chlorophyll *a* analysis. Furthermore, dissolved inorganic carbon (DIC) and pH profiles are collected at Harp, Plastic and Dickie lakes (Table 1).

Spring composite samples for the 'B' lakes (Appendix 4) are collected using the composite bottle (Appendix 1) for the upper 5 metres (Table 1).

Summer-stratified lake-sampling includes a Secchi determination, oxygen/temperature profiles, a light reading, volume-weighted water samples collected from each layer (using the peristaltic pump), phytoplankton and chlorophyll *a* samples, and a volume-weighted zooplankton sample. DIC and pH profiles are collected for Harp, Plastic and Dickie lakes (Table 1).

Table 1: Summary table of sampling protocols for the "A" and "B" lakes.

	Spring A lake	**Spring B lake**	**Summer A lake**
Collection method	pump and hose	composite bottle	pump and hose
Secchi depth	Yes	Yes	Yes
O_2 / temperature profiles	Yes	Yes	Yes
Light reading	Yes	Yes	Yes
Water sample	Yes	Yes	Yes
Phytoplankton / chlorophyll *a*	Yes		Yes
Zooplankton sample			Yes
DIC / pH profiles	*Yes		*Yes

* Harp, Plastic and Dickie lakes only

(B) Field Sampling Methods

Upon arriving at the sample site, securely anchor the boat or tie off to the deep station marker. In a weatherproof field book record the samplers' names, date, sampling time, and weather and lake conditions.

(i) Secchi depth

The first determination should be Secchi depth. Secchi depth is determined by lowering the Secchi disc (Appendix 1) through the water column on the shaded side of the boat until the disc just disappears from view. The disc is then raised until it just reappears. Secchi depth is the point midway between where the disc disappeared and where it reappeared and is recorded in metres to one decimal place. The person recording Secchi depth should not wear sunglasses while making the determination. Secchi depth is doubled to determine the depth of the euphotic zone (i.e. the depth used to collect the phytoplankton / chlorophyll *a* samples). Light readings are recorded to a depth of two times Secchi plus four metres, to ensure that the deepest readings are <1% of surface light. For example, if Secchi depth is 3.9 metres, then the euphotic zone can be estimated at 7.8 metres. The volume-weighted phytoplankton and chlorophyll samples should be collected from 1, 3, 5, and 7 metres and light readings taken to 12 metres (2x Secchi plus four metres).

(ii) Oxygen / temperature profile

Turn the oxygen/temperature meter on (Appendix 1) and allow it to stabilize for at least 15 minutes before use. Oxygen and temperature readings are taken at the surface (0.1 metres) and at every metre to the bottom of the lake. Caution should be used to avoid placing the oxygen probe in the lake sediments. Using an analog meter, the operator has to switch back and forth between the temperature mode and the oxygen mode for each reading. Using a digital meter, temperature and oxygen readings are displayed simultaneously. In a weatherproof field book, record temperature and oxygen readings to 0.1 degrees Celsius and 0.01 mg/L, respectively.

The upper and lower depths for each thermal layer (stratum) can be determined from the temperature profile. The epilimnion is the uppermost layer of mixed water. The top of the metalimnion is marked by the first temperature change of greater than one degree Celsius per metre. This layer sees the greatest temperature change through its depth. The top of the hypolimnion is the depth at which the temperature changes less than one degree Celsius per metre.

Three examples on the following page show typical stratified temperature profiles and the depths from which volume-weighted water samples are pumped (Figure 3). Note that samples are pumped from odd depths and that each odd depth is representative of a two metre stratum of water (i.e. water pumped from 1 metre is representative of the 0 – 2 metre stratum, 3 metres represents 2 – 4 metres, etc). When sampling an odd depth that includes the lower limit of the epilimnion and the upper limit of the metalimnion, or the lower limit of the metalimnion and the upper limit of the hypolimnion, the entire stratum is added to the layer in which the sampling depth falls.

When reporting the layer depths in the field notes and field data portion of the submission sheet, the depths are reported as even numbers. If the epilimnetic sample has been collected from 1 to 3 metres, its depth should be recorded as 0 to 4 metres (even if the actual depth is 0 to 3 metres). This is to ensure accuracy when calculating concentrations based on 2-metre volume-weighted strata.

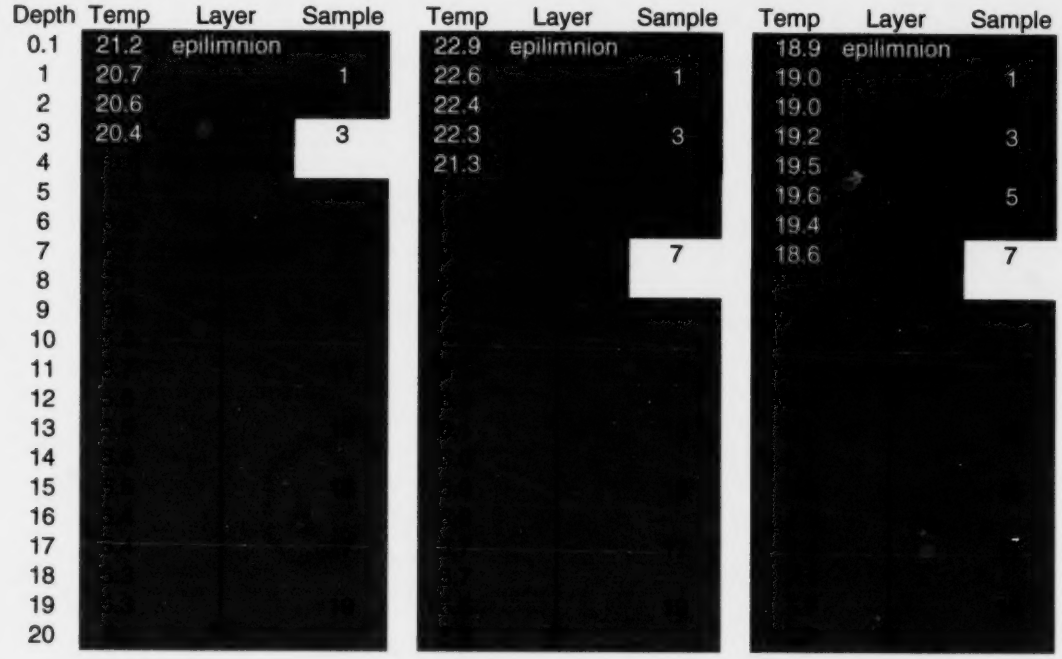

Figure 3. Diagram showing typical stratified temperature profiles, and the delineation of thermal strata.

(iii) Water chemistry samples

a. Spring turnover. Whole-lake composite samples are taken in the spring while lakes are mixed thermally and a single sample is presumed to be representative of the entire lake's chemistry.

(i) "A" lakes. The pump and hose system is used to collect whole-lake chemistry from the "A" lakes during the spring (Appendix 1). (See summer stratified procedure below for a description of the pump and hose method).

(ii) "B" lakes. The composite sample bottle is used to obtain the whole-lake chemistry sample from "B" lakes (Appendix 1). While wearing vinyl gloves, the bottle is carefully rinsed with surface water three times and then lowered and raised slowly through a depth of five metres. After the bottle is brought back to the surface, the sample is poured through an 80 µm filter into the appropriate sample bottles and tubes (Appendix 1). Sample containers should be rinsed three times before they are filled.

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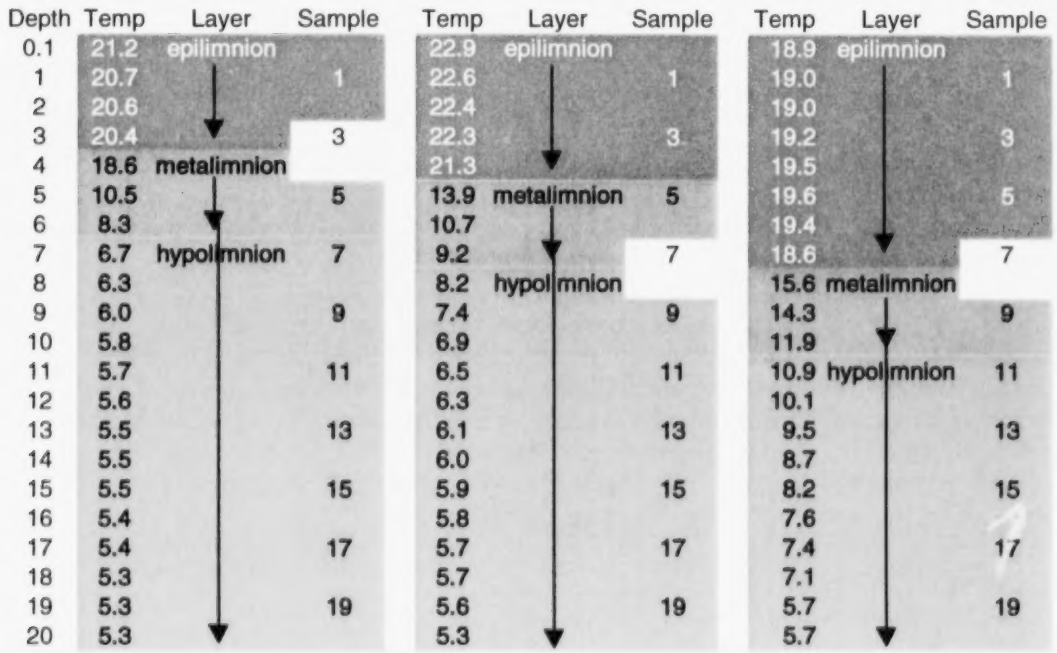

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a. Spring turnover. Whole-lake composite samples are taken in the spring while lakes are mixed thermally and a single sample is presumed to be representative of the entire lake's chemistry.

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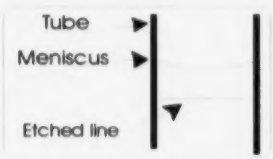
b. Summer stratified. A peristaltic pump and metered / weighted hose are used to obtain composite chemistry samples that will describe water chemical conditions in each of the three thermally-stratified layers. While wearing vinyl gloves to reduce handling contamination, the first 25 metre section of hose is attached to the peristaltic pump (note that a second, 15 m length of hose is added when pumping Harp and Red Chalk Main), and the weighted end of the hose is lowered to depths of 0.1 or 1.0 metres (i.e. 0.1 m for pH / DIC profiles and 1.0 m for volume-weighted sample collection). After starting the pump, at least three litres of lake water is allowed to pump through the hose before the first sample is collected. The graduated cylinder, filter and labeled sample-collection jugs (rinse with filtered water) should be rinsed thoroughly.

Pump water for each layer [the depth of each layer is determined by the temperature profile – see discussion above]. The volume-weighting chart is used to determine the volume collected per depth for each of the 'A' lakes (see Form 1 for details). Volume-weighted samples are collected so that the composite sample for each layer contains a proportionate volume of water from each odd depth within that layer. In simple terms, in a given lake there is a greater proportion of the total volume at 1 metre than there is at 5 metres or 10 metres. There is, therefore, a proportionately greater volume collected at one metre than at deeper depths. The volume required from each depth is pre-calculated according to each lake's morphometry. The water for each layer is pumped into the graduated cylinder to precisely measure volume and then poured into the appropriately labeled jug through the 80 µm filter (the phytoplankton and chlorophyll samples are <u>not</u> filtered). Collect a large enough volume of water to allow each sample container to be rinsed 3 times before being filled (approx. 2.5 – 3.0 litres).

After having obtained a composite sample from each strata, rinse each pre-labeled sample container three times and fill. Gas capped containers (DIC, alkalinity) should contain no bubbles and the Phosphorus tubes (in duplicate) should be filled to about 1cm above the etched line. See diagram to right.



(iv) Profile samples (Harp, Plastic and Dickie lakes only)
The pH bottles and DIC tubes are filled directly from the hose at each appropriate depth (0.1 metres, 1.0 metre and at every odd metre to the lowest obtainable depth). Both pH bottles and DIC tubes have gas caps and therefore should be bubble-free. All samples are placed in a cooler and returned to the DESC Chemistry lab (Appendix 8) for submission and refrigeration as soon as possible.

(v) Phytoplankton and chlorophyll <u>a</u>
The phytoplankton and chlorophyll composite samples are taken starting at 1.0 metre and then at each odd metre to the bottom of the euphotic zone (defined as two times the Secchi depth - if the euphotic zone is 0 to 8 metres then the phytoplankton sample should be collected at 1, 3, 5 and 7 metres). The lake-specific volume-weighting chart is used to determine the volume pumped at each metre. Each sample is pumped into the graduated cylinder and then poured into the labeled 4 litre phytoplankton jug. Note that the phytoplankton and chlorophyll samples are <u>not</u> filtered. Once the composite sample has been collected, gently swirl it to thoroughly mix it. The

phytoplankton sample is poured into a pre-labelled 500 mL PET jar and 1.0 mL (40 drops) Lugol's preservative is added (see Appendix 2 for recipe). The lid is tightened onto the jar and the sample is shaken gently. The chlorophyll sample is poured into a rinsed, pre-labelled brown one litre Nalgene bottle.

(vi) Light readings

The Li-1400 data logger is removed from its protective case and the reference, up-welling, and down-welling cables are attached to the data logger using the bayonet-style cable attachments. The reference probe, which is attached to a small retort stand, is placed so that it is free from shadow and reflection (preferably on the gunwale or the bow). A small volume (approx. 3.0 mL) of lake water is poured onto the surface of the reference sensor. Note that there should be no bubbles in this water. The Li-1400 is turned on and the first reading is taken by dipping the sensors into the water and then lifting and holding the sensors just above the lake surface and pressing the enter button. Care should be taken to avoid placing sensors within the boat's shadow. The Li-1400 will integrate data for 15 seconds after the enter button has been pressed. Using the built-in clock, allow 18 seconds to pass before moving the sensors to the next depth and pressing the enter key. Readings should be taken just above the lake surface, just below surface, at 0.5 metres, and at every full metre to a depth of two times Secchi plus four metres (not possible in all lakes because of depth limitations).

(vii) Zooplankton

Zooplankton are collected using a 12.5 cm wide, 80 cm long, 80 µm Dorset net (Appendix 1). For each lake there is a specific set of haul depths (predetermined using volume-weighting - see section *(iii)* Water chemistry samples, subsection b. Summer Stratified for more information on volume-weighting). A volume-weighted composite sample is collected by combining the contents of several vertical hauls, each starting at a different depth and terminating at the lake surface (see Form 1 for details). Typically, the contents of 4 or 5 hauls are combined to form the composite sample.

1. Start by securely attaching the net to the impeller (more commonly referred to as the meter) using the ring clamp (Appendix 1). The ring clamp should be positioned so that the tightening mechanism is positioned on the meter's cross brace otherwise the meter's shape could be compromised. Be sure that the net hangs straight from the meter.
2. The cod end (be sure the pin is in place) is securely attached to the net. µ
3. Record the pre-haul counter reading in the field book. Before and after counter readings should be recorded in the field book for each haul.
4. The net is then lowered to the first depth and held in a resting position for 10 to 15 seconds. The net is retrieved at a rate of at least 1 metre per second. After each haul the post-haul counter reading is recorded in the field book.
5. The sample is rinsed into a PET jar using a Nalgene wash bottle. Repeat steps 4 and 5 for remaining depths.

6. The combined sample is then poured back into the cod end and as much lake water as possible is removed using a gentle swirling action. The sample is rinsed back into the PET jar with minimal water and a volume of 8% sugar formalin equaling the volume of the sample is added to the PET jar to produce a final preservation volume of 4% sugar formalin (see Appendix 3 for recipe).
7. After the final haul the net is removed, the clamp is reattached (in the same position as the netted haul) and a final no-net haul is pulled from the depth of the deepest netted haul. Again before and after counter readings should be recorded in the field book. This haul determines net efficiency. The no-net haul should yield approximately 2 counts per meter.

III. INVASIVE SPECIES

(A) *Bythotrephes longimanus*

With the recent invasion of Harp Lake by the zooplankton *Bythotrephes longimanus* care must be taken to avoid spreading it to other lakes. Up to the end of the 2002 sample season, the boat was washed using the hose and the zooplankton net was sprayed with a mild (10%) bleach solution after sampling Harp Lake. Furthermore, Harp was always sampled last in the rotation so that the equipment could dry for a week before being used again. As of the 2003 sampling season a full set of sampling equipment including a boat, motor and trailer will be dedicated solely for use at Harp Lake. Upon returning to the lab, the boat will be washed using the hose and bleach solution.

(B) Sampling Routine for *Bythotrephes longimanus*

Sampling of *Bythotrephes* at Harp Lake is conducted on a monthly basis (typically late in the month) during the ice-free season at nine randomly chosen sites and the deep-station. The following procedure is followed to select sampling locations:

1. Using the Stratified Random Sampling Design, Harp Lake is divided into three lake regions and three depth zones (Appendix 7). The three depth zones are 0-9 m, 9-21 m, and more than 21 m. The deep station is 35-37 metres, depending on the time of year and wind direction.
2. Three sample sites are selected in each zone, from each of the three sampling depths (i.e., a total of nine locations).
3. To select sites, a 26 by 26 square grid is copied onto the map of Harp Lake. Random pairs of numbers between 1 and 26 are generated using the RAND (Microsoft Excel) function [RAND()*(26-1)+1)].
4. From the list of numbers, the first nine pairs that meet the aforementioned criteria (i.e. one pair for each of three depth zones per region) are used to determine sampling locations.

Once locations have been selected, the following equipment should be collated:

- 0.75-m x 3-m net and a 285-µm cod end
- map of Harp Lake marked with random sample sites
- depth finder
- anchor
- 10 labeled PET jars (Harp Lake, date, site number, water depth, and haul depth)
- 8% sugar formalin
- wash bottle
- pens/pencils/markers

Using the depth finder locate the appropriate depth and securely anchor the boat. Securely attach the cod end and lower the net to 2.5-3 metres shallower than the bottom. Allow the net to sit at depth for at least 30 seconds before retrieving. When retrieving the net, a haul speed of one metre per second should be maintained. Once the net has been retrieved, the contents should be

washed into the cod end by splashing lake water on the outside of the net. Remove the cod end carefully, rinse contents into the appropriately labeled PET jar (keeping in mind that *Bythotrephes* will stick to the mesh), and mix 50:50 with 8% sugar formalin for a 4% formalin preserved sample.

IV. HEALTH AND SAFETY

To avoid the potential hazards of lake sampling please follow these Dorset Health and Safety protocols (for further information refer to "The Dorset Environmental Science Centre Health and Safety Orientation Manual"):

- Always sign out and sign back in. Make arrangements to notify someone of your return if returning after normal work hours.
- Never sample a lake alone. Always sample with someone.
- Always wear a personal flotation device. Fanny pack inflatable and full vest style PFDs are available. During cold weather, when surface water temperatures are below 10 degrees Celsius, survival suits or floater coats must be worn.
- When sampling in a remote location (e.g., Westward, Crosson) a satellite phone and first aid kit should be carried.
- No one should attempt to operate an outboard motor without first having had thorough instruction.
- No one should attempt to trailer a boat or back a trailer into a lake without first having had thorough instruction. When backing into a lake have the passenger provide guidance from a safe distance.
- When handling preservatives (Lugol's and 8% Sugar Formalin) care should be taken to avoid eye or skin contact and spillage. Note that preservatives should be WHMS labeled.
- During hunting season blaze orange should be worn.
- A boat (or canoe) safety kit must always be carried. The kit should include a floating rope, a whistle, a reflective device, a flashlight and a bailing bucket.
- The canoe should be strapped tightly to the canoe rack using two ratchet straps or ropes and a safety rope from the nose of the canoe to the hook on the front bumper of the truck.
- Be aware of the boat or canoe capacity. Don't overload.
- When flying to remote lakes, be prepared for the possibility of having to stay overnight. Bring extra clothing, food and water.
- Obtaining a safe boaters card will help in understanding the rules of safe boating.
- Protection against the sun is advisable. This should include a hat, sunglasses and waterproof sun block.
- Be aware of the spread of West Nile virus via mosquito bite
- Survival kits are available to anyone sampling in a remote area
- Wear appropriate footwear. Open-toe shoes are not acceptable for field work.

V. SAMPLE SUBMISSION

(A) General

In June 2000, the procedures changed for submitting samples to the chemistry labs in Dorset. These changes were necessary to allow tracking of sample information from the new Trent Labs to the DESC database. Changes were also necessary to reduce the amount of effort required to log samples onto the ministry LIMS system. In future, field data will be loaded to Oracle tables directly from the electronic versions of the Sample Submission and Field Data Forms. The person submitting the samples will be responsible for filling out the forms completely and correctly. Generally the changes have made the process of submitting samples more accurate and efficient.

(B) What Has Changed?

1. The old LIMS Routine Sample Submission Form has been replaced by the Sample Submission and Field Data Form which is a more compact, spreadsheet-style form.

2. Samples can now be submitted to either MOE or Trent Labs using the same form. Note that all sample LAB SAMPLE NUMBERS are assigned by the MOE lab regardless of the sample's destination.

3. Field data are still recorded on the submission forms by whoever is submitting samples. However, this information is not included on the portion of the submission form that accompanies the samples to the lab. The field data will be entered directly to the *ALL_SAMPLES* table in the DESC, Oracle database using an automated system which will read the electronic version of the Sample Submission and Field Data Form. Field data was previously included on sample submission forms and entered into the database by MOE Lab staff.

4. Persons submitting samples to the lab must now keep track of the sample's LAB SAMPLE NUMBERS. These numbers must accompany the field data to allow the database to match field data to the sample analysis information that returns from the labs directly to the *ALL_RESULTS* table in the DESC Oracle database. The automated system will not record fields until the LAB SAMPLE NUMBERS have been entered.

5. Condition Codes have been replaced by the Sample Description field.

6. Two new field data descriptors - Sample Gear Type and Special Study ID have been added to make data retrieval easier and more precise.

(C) Instructions for Submission of Lake Samples

1. Ensure that every sample bottle is labeled with either a Field Sample I.D., or a clear Sample Location Description (LDESC), e.g., PC – EPI

2. Prior to submitting samples, call up a blank Sample Submission and Field Data Form found in "*Desc_ntfs3/Samp_sub/BLANK_FORMS/Lakes*" (Form 2). From the subdirectories choose the appropriate *lake* form.

3. Accurately fill out the following fields: Date Submitted, Sampled by, Cont Sent, **STATION** (Appendix 5), **DATE** and **TIME**, **LDESC**, **PARENT PRODUCT** and **PRODUCT**. In the "Lake Submission Form Templates" directory, Cont Sent, **STATION**, **LDESC**, **PARENT PRODUCT** (Appendix 6) and **PRODUCT** (Appendix 6) are already filled in. Fill out the FIELD DATA PORTION of the form (this is for the electronic record only, and is not submitted to Chemistry). Name the file (form) using the correct name and date (for example if Harp lake was sampled August 19, 2001 then the file name would be 'Harp 190801') and save the form to "*Desc_ntfs3/Samp_sub/Incomplete Lake Submission forms*". Print two hard copies of the submission form; one copy for the samplers' records and a copy that accompanies the samples to the chemistry lab (Form 3).

4. Leave the sample submission form together with the samples on the counter in the MOE lab (Appendix 8; building #18) sample reception area. The samples should be lined up on the submission counter in the same order they appear on the submission form. Note that if you are requesting both MOE and Trent Lab tests, you should leave two copies of the submission form and instruct the chem lab to send one form to the Trent Lab with the associated bottles. If you are submitting samples only to the Trent Lab, MOE lab staff will assign special SUBNUM and LAB SAMPLE NUMBERS (see description below) to each sample and these will go with the sheets to the Trent Lab. These numbers will not be logged onto the LIMS system.

5. If for any reason the samples cannot be submitted to Chemistry until the next day, they should be refrigerated in the Chemistry lab (Appendix 8; building #18) sample fridge or the biology fridge (Appendix 8; building #17) (e.g., phytoplankton samples), until submission can be completed.

6. It will take the lab staff some time to assign a SUBNUM (see Forms 2 and 3), and LAB SAMPLE NUMBERS to your samples. You will have to return to the MOE lab at some point after the samples have been logged in and record the SUBNUM on your copy of the Sample Submission and Field Data Form. Following this, LAB SAMPLE NUMBERS will be filled in automatically. Make sure the field data is complete before adding the SUBNUM to the Incomplete Submission Form. SUBNUM and LAB SAMPLE NUMBERS can be found in the log book or on the face (as sticky labels) of the submission sheets that you left with the samples. They may be in a filing cabinet if you have waited for several days.

(D) Sample Submission Forms – Glossary of Terms

(i) Part 1: Sample submission (the left hand portion of the form)

Sample Submission and Field Data Forms have been produced in generic formats for the submission of lake samples. For the more commonly samples lakes, templates have been prepared and can be found in "*Desc_ntfs3/Samp_Sub\BLANK_FORMS/Lakes/Lake Submission Form Templates*".

These forms include all of the same information that was recorded on the old LIMS forms. The key difference is that only the left portion of the form is printed to use as a sample submission form. This is because lab personnel are no longer entering the field data that is recorded on the right hand portion of the sheet. This field data will be entered into Oracle tables automatically. The critical step is to include the SUBNUMS and LAB SAMPLE NUMBERS that are assigned to the samples by the lab onto your electronic copy of the submission form ***BEFORE*** the field data can be entered into Oracle tables (see above instruction)

Client ID and Program Codes
These codes change on an annual basis. You must determine which Client ID to use and enter a valid program code to submit samples to the MOE lab. The Trent Lab at this point does not require these codes.

Station ID Code
Sample station information is stored in two tables in *geographic_mgr*. The lake that the water has been taken from or the lake that the stream flows into will be described in *geographic_mgr_body_of _water*. Each body of water may have multiple stations and these will by listed together with the body of water code in the *geographic_mgr_stations* table. Determine the station based on the description and enter the 11 digit number with your data. If you are sampling a new station you will be required to add information about the new location to the *geographic_mgr_stations* table and possibly to the *geographic_mgr_body_of _water* table. This will allow the creation of a new Station ID code. You will need to get in touch with a database person to do this.

Parent Product and Product Codes
These codes determine which tests are being requested for the samples that are being submitted. These codes often change so check for current valid codes. Generally if you are repeatedly asking for the same suite of parameters there will be a Parent Product code set up for you. This saves listing individual test or product codes. For example DRCSTRMB is a parent product code used to request all of the routine Dorset streams chemistry tests. Individual products can be entered as required i.e., TP3036 for total phosphorus. See the MOE chemistry lab personnel for valid parent product and product codes.

Trent Lab Submissions will not use Parent Products. Product Codes for the Trent Lab usually include the parameter name with a 'TR' prefix i.e., TRDOC, TRPPUT, etc.

(ii) Part 2: Field data (the right hand portion of the form)

The field data which is entered on the right hand portion of the Sample Submission and Field Data Form will be unique to the type of sample that is being submitted. All samples require a SAMPLE TYPE AND GEAR TYPE. Lake samples will require a great deal of additional field data including TYPE, LAYER, SDEPTH, BGDEPTH, WDEPTH, etc. Stream samples require only a SDESC (Sample Description) and sometimes TEMP. Some samples such as those that originate from a lab experiment may require no further entry of field data. Samples of all types collected for special studies require a SPECIAL_STUDY_ID.

Field data will be transferred automatically to the DESC, Oracle database, *ALL_SAMPLES* table. Therefore, field data can be entered for only those parameters that exist in the *ALL_SAMPLES* table. Again make sure that the lab assigned LAB SAMPLE NUMBER for each sample is added to your field data after the field data has been entered. It will be required to upload the data.

Form Fields - Explanations and Codes

(Subsets of these 'Fields' will be used depending on the origin of the samples).

STATION	11 digit sample location number from *geographic_mgr_stations* table
DATE	sample collection date
TIME	sample collection time
INITIAL DATE	start of sample period, initiation date
INITIAL TIME	start of sample period, initiation time
SUBNUM	first part of the LAB SAMPLE NUMBER - assigned by Lab staff
FIELD SAMPLE NUMBER	second part of the LAB SAMPLE NUMBER - entered by field staff (In most cases the first sample starts with the number 1, each subsequent sample increments by 1)
LAB SAMPLE NUMBER	Combined SUBNUM and FIELD SAMPLE NUMBER Each sample submitted for analysis to an MOE or TRENT lab **must** have a Lab Sample Number. It is the responsibility of the person submitting the samples (this means you) to enter the FIELD SAMPLE NUMBER and to add the SUBNUM to each form when it becomes available. The LAB SAMPLE NUMBER field is updated automatically when the SUBNUM is entered. Field data cannot be loaded to the Oracle tables until the Lab Sample Numbers have been added to the

completed forms. *Make sure that the field data information on the form is complete before adding the Lab Sample Numbers.* It is a good idea to establish a routine (weekly or bi-weekly) to retrieve the Subnums from the lab and add them to the forms.

Procedure for adding Lab_Sample_Numbers:

- Check that all of the required field data has been added to the form
- Make sure that the Field_Sample column is filled out. Field Samples always start with 1 and increment by 1.
- Retrieve the Subnum from the Chemistry Lab and enter it into Cell S1 on the Sample Submission and Field Data Forms. The Lab Sample Number column will be updated automatically.
- Save the file.
    - Note that for some non-routine submissions the Field_Sample column may not meet the above criteria. In these cases the Lab Sample Number column must be filled out manually.

STYPE — sample type

10	profile	lakes
11	grab sample (single depth)	lakes, streams, groundwater
12	depth composite	lakes
61	wet only collector	precip
62	bulk collector	precip
63	on ground snow	precip
71	groundwater	

CONT. SENT — number of sample containers submitted for each sample

LDESC — sample location description (i.e. BC-epi)

SDESC — sample description, NOTE NEW - add information that would be recorded as former CONDITION_CODE (i.e., pollen in sample, etc.)

SDEPTH — sample depth or top of composite for type 12 samples

BGDEPTH — bottom of composite sample for type 12 samples

WDEPTH — depth of water at sample location

WLAYER

1	whole lake composite (spring and fall turnover)
2	epilimnion
3	metalimnion
4	hypolimnion
5	euphotic zone (surface to 2 x Secchi)
8	grab (Kemmerer etc. use with type = 11)
9	general layer (0-5 m composite etc.)

TEMP		Water temperature	
SAMPLE_GEAR_ TYPE	1	hand sample - bottle filled by hand	(all media)
	2	peristaltic pump	(lake/groundwater)
	3	Van Dorn or Kemmerer Bottle	(lake)
	4	tube composite	(lake)
	5	composite bottle	(lake)
	6	Sangamo collector	(precip)
	7	Aerochemmetric collector	(precip)
	8	MIC collector	(precip)
	9	bulk collector (summer funnel)	(precip)
	10	bulk collector (winter funnel)	(precip)
	11	hand held manual pump	(groundwater)
	13	lysimeter (zero tension)	(groundwater)

SPECIAL STUDY_ID: By entering a unique number into this field it will be possible to retrieve all of the data from the database associated with your study. It simply creates an easy way to query your data. If you plan to submit samples as part of a unique study, Joe will assign you a SPECIAL_STUDY_ID which will be entered into a separate table with a study description.

VI. REFERENCES

Clark, B., 1996. Limnological sample and data collection methods used by the Muskoka Lakes Aquatic Assessment Unit. Ontario Ministry of Environment Report ISBN 0-7778-5757-X.

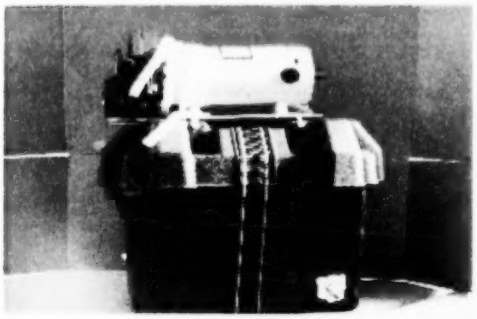
Girard, R.E., Clark, B.J., Yan, N. D., Reid, R. A., David, S. M., and Findeis, J. G. 2001. History of Chemical, Physical and Biological Sampling Methods, Sample Locations and Lake Morphometry for the Dorset Environmental Science Centre (1973 – 2001).

Findeis, J. G. and Clark, B. J. 2000. Sample Submission to MOE and Trent Labs at the Dorset Environmental Science Centre.

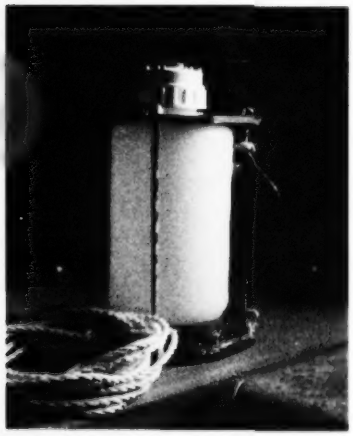
Appendix 1. Field sampling equipment

Secchi Disk

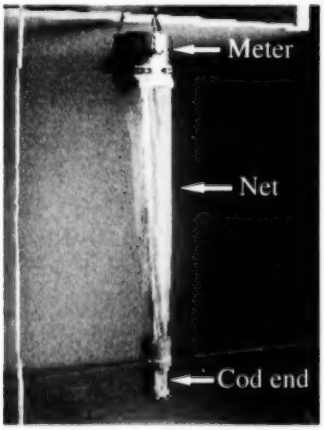
Peristaltic pump and battery



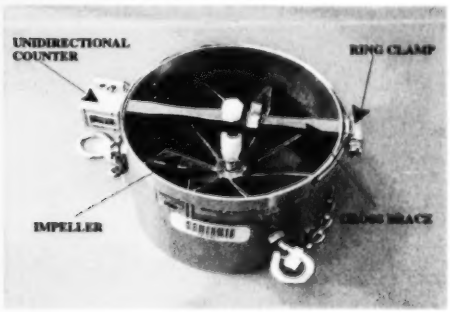
Composite bottle



DRC zooplankton net



Zooplankton net impeller (meter) with unidirectional counter

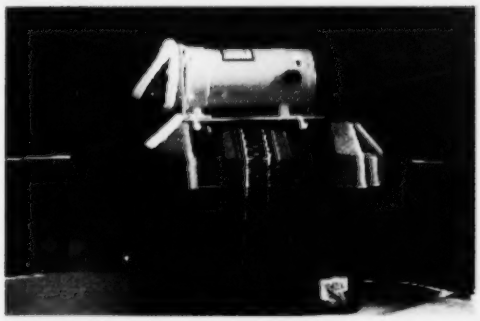


Oxygen/Temperature meter

Appendix 1. Field sampling equipment

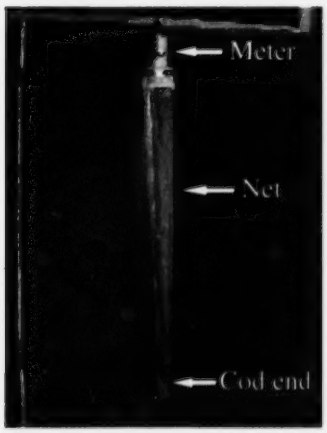
Secchi Disk

Peristaltic pump and battery

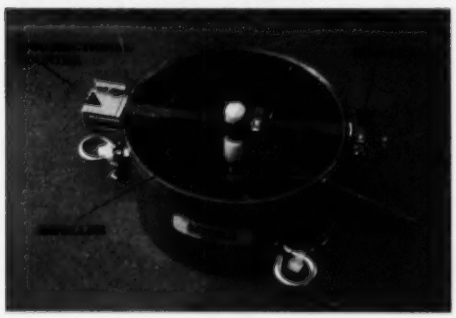


Composite bottle

DRC zooplankton net



Zooplankton net impeller (meter) with unidirectional counter



Oxygen/Temperature meter

Sample containers, including: a) yellow cap jar; b) square 1-Litre Nalgene chlorophyll bottle; c) PET jar; d) Etched phosphorus tubes; e) DIC tube; and f) pH-alkalinity bottle

Appendix 2. Recipe for Lugol's (algal preservative)

- 50 g iodine
- 100 g KI (potassium iodide)
- 1 L deionized water

Appendix 3. Recipe for 8% sugar formalin (zooplankton preservative)

- 5 litres deionized water
- 360 g sugar
- 620 mL formalin
- 43 drops 0.5 N NaO

Appendix 4. Sampling frequency of 'A' and 'B' lakes.

"A" lakes streams are regularly sampled
(Heney and Crosson no longer are)

A lakes	Sampling frequency
Dickie	bi-monthly
Harp	bi-monthly
Plastic	bi-monthly
Blue Chalk	Monthly
Chub	Monthly
Crosson	Monthly
Heney	Monthly
Red Chalk East	Monthly
Red Chalk Main	Monthly
Ridout	Monthly

"B" lake streams are not regularly sampled

B lakes	Sampling frequency
Basshaunt	yearly (spring)
Bigwind	yearly (spring)
Brandy*	yearly (spring)
Buck	yearly (spring)
Cinder East	yearly (spring)
Cinder West	yearly (spring)
Clear	yearly (spring)
Fawn	yearly (spring)
Glen	yearly (spring)
Gullfeather	yearly (spring)
Hamer	yearly (spring)
Healey	yearly (spring)
Leech	yearly (spring)
Leonard	yearly (spring)
Little Clear	yearly (spring)
McKay	yearly (spring)
Moot	yearly (spring)
Mouse	yearly (spring)
Pearceley	yearly (spring)
Poker East	yearly (spring)
Poker West	yearly (spring)
Solitaire	yearly (spring)
Ranger	yearly (spring)
Walker	yearly (spring)
Westward	yearly (spring)
Young	yearly (spring)

Appendix 5

Lake Station I.D. Codes

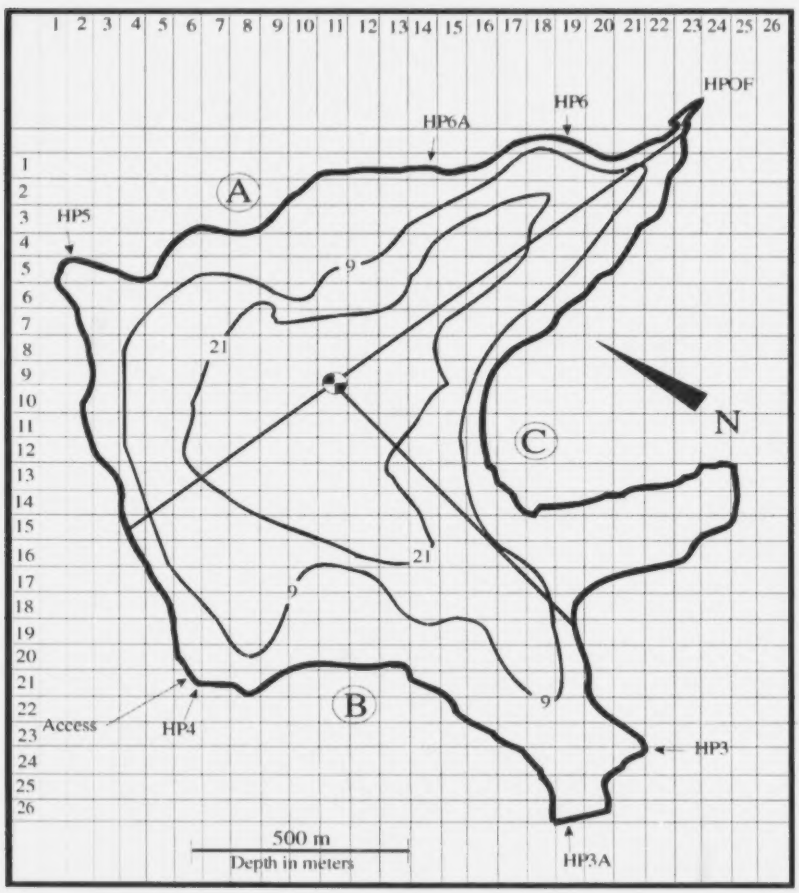
LAKE	STATION
BASSHAUNT LAKE	17002152001
BIGWIND LAKE	03008550001
BLUE CHALK LAKE	03007754001
BRANDY LAKE	03008563101
BUCK LAKE	03008554001
CHUB LAKE	03008553001
CINDER LAKE EAST	03007751701
CINDER LAKE WEST	03007751601
CLEAR LAKE	17002153001
CROSSON LAKE	03007751001
DICKIE LAKE	03008551001
FAWN LAKE	03008563201
GLEN LAKE	17002151001
GULLFEATHER LAKE	03007750001
HAMER LAKE	99004000601
HARP LAKE	03008557001
HEALEY LAKE	03008563301
HENEY LAKE	03008550501
LEECH LAKE	03008563501
LEONARD LAKE	03008563401
LITTLE CLEAR LAKE	03008559001
McKAY LAKE	03008563701
MOOT LAKE	03008563601
MOUSE LAKE	03007757001
PLASTIC LAKE	17002154001
POKER LAKE EAST	03007751401
POKER LAKE WEST	03007751501
RANGER LAKE	17002159D01
RIDOUT	9999ASS4867
RED CHALK LAKE EAST	03007752001
RED CHALK LAKE WEST	03007552101
SOLITAIRE LAKE	03008560001
WALKER LAKE	03008555001
WESTWARD LAKE	03008561001
YOUNG LAKE	99004001201
PEARCELEY LAKE	98020150101
SKIDWAY LAKE	98020120101

Indicates A Lake

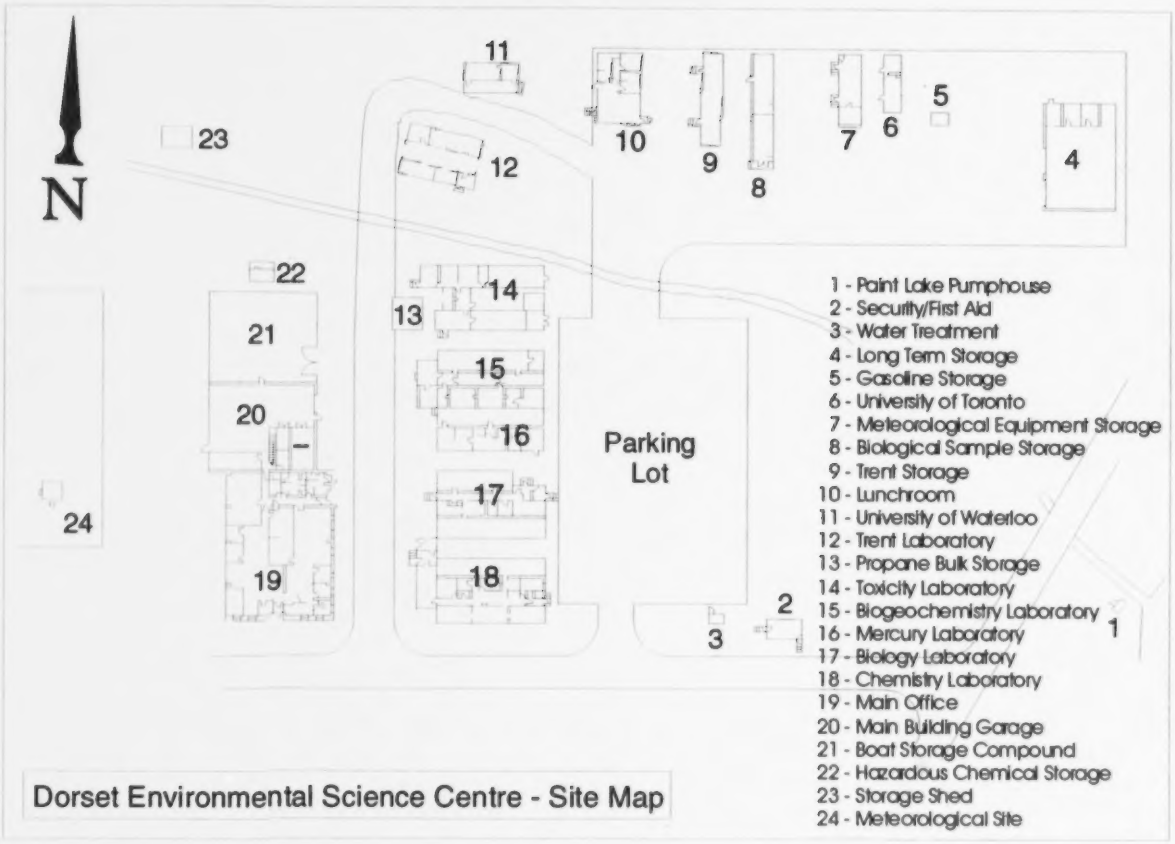
Appendix 6. Analytical parameter codes for water chemistry.

PARENT PRODUCT	PRODUCT	CODE
DRCLKA	ph / ALKALINITY	PHALK 3042
	COLOUR	COL 3025
	CONDUCTIVITY	COND 3024
	AMMONIUM	AMMNO 3374
	TOTAL PHOSPHORUS	TP 3036
	DISSOLVED ORGANIC CARBON	DORCSi 3422
	DISSOLVED INORGANIC CARBON	CARB 3028
	ANIONS (SO4, Cl)	ANION 3147
	CATIONS (Ca, Mg, Na, K)	CAT 3249
	TOTAL KJELDAHL NITROGEN	DTKN 3424
	METALS	MET 3386
DRCCHLO	CHLOROPHYLL	DCHL3169

Appendix 7. Map and grid for determining *Bythotrephes* sampling locations in Harp Lake



Appendix 8. Site Map


N
Parking Lot
Dorset Environmental Science Centre - Site Map
1 - Paint Lake Pumphouse
2 - Security/First Aid
3 - Water Treatment
4 - Long Term Storage
5 - Gasoline Storage
6 - University of Toronto
7 - Meteorological Equipment Storage
8 - Biological Sample Storage
9 - Trent Storage
10 - Lunchroom
11 - University of Waterloo
12 - Trent Laboratory
13 - Propane Bulk Storage
14 - Toxicity Laboratory
15 - Biogeochemistry Laboratory
16 - Mercury Laboratory
17 - Biology Laboratory
18 - Chemistry Laboratory
19 - Main Office
20 - Main Building Garage
21 - Boat Storage Compound
22 - Hazardous Chemical Storage
23 - Storage Shed
24 - Meteorological Site

Form 1. Volume weighted charts for the Dorset 'A' lakes showing the amount of water to be pumped at each depth to achieve a final volume of three litres for each stratified layer (e.g., epi, meta, or hypolimnion). Zooplankton haul depths are shown to the right.

DICKIE — VOLUME PUMPED IN mL

DEPTH	UNSTRATIFIED	STRATIFIED A	B	C	D	E	F	G
1 m	1080	3000	3000	3000	1681	1681	1681	1306
3 m	847	3000	1815	1457	1319	1319	1319	1025
5 m	554		1185	951	3000	3000	1851	669
7 m	344			592			1149	3000
9 m	158							
11 m	20							
TOTAL VOLUME	3001	3000	3000	3000	3000	3000	3000	3000
		3000	3000	3000	3000	3000	3000	3000

EPI
META

ZOOPLANKTON HAUL DEPTH
2 m
4 m
6 m
8 m

HENEY — VOL. PUMPED IN mL

DEPTH	UNSTRATIFIED A
1 m	1620
3 m	1149
5 m	231
TOTAL VOLUME	3000

ZOOPLANKTON HAUL DEPTHS
2 m
2 m
4 m
5 m

PLASTIC — VOLUME PUMPED IN mL

DEPTH	UNSTRATIFIED	STRATIFIED A	B	C	D	E	F	G	H	I
1 m	712	3000	1599	1599	1599	1150	940	828	828	762
3 m	625	3000	1401	1401	1401	1010	825	727	727	669
5 m	520		3000	1668	1256	840	687	605	605	556
7 m	415			1332	1002	1315	548	483	483	444
9 m	307				742	973	1731	357	357	328
11 m	225					715	1269	3000	1824	241
13 m	145								1178	3000
15 m	52									
TOTAL VOLUME	3002	3000	3000	3000	3000	3000	3000	3000	3000	3000
		3000	3000	3000	3000	3000	3000	3000	3000	3000

EPI
META

ZOOPLANKTON HAUL DEPTH
3 m
7 m
11 m
15 m

HARP

VOLUME PUMPED IN mL

DEPTH	UNSTRATIFIED	STRATIFIED A	B	C	D	E	F	G	H
1 m	596	3000	1605	1605	1140	1192	906	768	678
3 m	518	1597	1395	1395	990	1036	789	666	590
5 m	455	1403	3000	1591	870	910	693	588	518
7 m	403			1409	1591	3000	612	519	459
9 m	357				1409		3000	459	406
11 m	307							3000	350
13 m	264								3000
15 m	229								
17 m	193								
19 m	170								
21 m	140								
23 m	113								
25 m	86								
27 m	60								
29 m	43								
31 m	27								
33 m	15								
35 m	9								
TOTAL VOLUME	3985	3000	3000	3000	3000	3000	3000	3000	3000
		3000	3000	3000	3000	3000	3000	3000	3000

EPI
META

ZOOPLANKTON HAUL DEPTH
6 m
6 m
13 m
21 m
30 m

CHUB

VOLUME PUMPED IN mL

DEPTH	UNSTRATIFIED	STRATIFIED A	B	C	D	E	F	G	H
1 m	611	3000	3000	1653	1653	1208	1208	990	861
3 m	498	3000	1647	1347	1347	984	984	807	701
5 m	409		1353	1651	1202	808	808	663	576
7 m	334			1349	981	3000	1637	541	470
9 m	278				817		1363	3000	392
11 m	256								3000
13 m	188								
15 m	144								
17 m	111								
19 m	83								
21 m	59								
23 m	38								
25 m	12								
TOTAL VOLUME	3018	3000	3000	3000	3000	3000	3000	3000	3000
		3000	3000	3000	3000	3000	3000	3000	3000

EPI
META

ZOOPLANKTON HAUL DEPTH
4 m
4 m
9 m
15 m
20 m

Form 1. Volume weighted charts for the Dorset 'A' lakes showing the amount of water to be pumped at each depth to achieve a final volume of three litres for each stratified layer (e.g., epi, meta, or hypolimnion). Zooplankton haul depths are shown to the right.

DICKIE

VOLUME PUMPED IN mL

DEPTH	UNSTRATIFIED	STRATIFIED A	B	C	D	E	F	G	
1 m	1080	3000	3000	3000	1681	1681	1681	1306	EPI
3 m	847	3000	1815	1457	1319	1319	1319	1025	META
5 m	554	1545	1185	951	3000	3000	1851	669	HYPO
7 m	344	961	1981	592	1981	2081	1149	3000	
9 m	158	439	904	2861	904	939	2861	2861	ZOOPLANKTON
11 m	20	56	115	339	115		339	339	HAUL DEPTH
									2 m
TOTAL VOLUME	3001	3000	3000	3000	3000	3000	3000	3000	4 m
		3000	3000	3000	3000	3000	3000	3000	6 m
		3000	3000	3000	3000	3000	3000	3000	8 m

HENEY

VOL. PUMPED IN mL

DEPTH	UNSTRATIFIED A	
1 m	1620	ZOOPLANKTON
3 m	1149	HAUL DEPTHS
5 m	231	2 m
		2 m
TOTAL VOLUME	3000	4 m
		5 m

PLASTIC

VOLUME PUMPED IN mL

DEPTH	UNSTRATIFIED	STRATIFIED A	B	C	D	E	F	G	H	I	
1 m	712	3000	1599	1599	1599	1150	940	828	828	762	EPI
3 m	625	3000	1401	1401	1401	1010	825	727	727	669	META
5 m	520	935	3000	1668	1256	840	687	605	605	556	HYPO
7 m	415	748	1088	1332	1002	1315	548	483	483	444	
9 m	307	553	805	1263	742	973	1731	357	357	328	ZOOPLANKTON
11 m	225	406	590	926	1600	715	1269	3000	1824	241	HAUL DEPTH
13 m	145	261	380	597	1031	2208	2208	2208	1178	3000	3 m
15 m	52	94	136	214	370	792	792	792	3000	3000	7 m
											11 m
TOTAL VOLUME	3002	3000	3000	3000	3000	3000	3000	3000	3000	3000	15 m
		3000	3000	3000	3000	3000	3000	3000	3000	3000	
		3000	3000	3000	3000	3000	3000	3000	3000	3000	

HARP

VOLUME PUMPED IN mL

DEPTH	UNSTRATIFIED	STRATIFIED							
		A	B	C	D	E	F	G	H
1 m	596	3000	1605	1605	1140	1192	906	768	678
3 m	518	1597	1395	1395	990	1036	789	666	590
5 m	455	1403	3000	1591	870	910	693	588	518
7 m	403	500	500	1409	1591	3000	612	519	459
9 m	357	443	443	532	1409	532	3000	459	406
11 m	307	381	381	458	556	458	556	3000	350
13 m	264	328	328	393	478	393	478	587	3000
15 m	229	284	284	341	415	341	415	509	633
17 m	193	240	240	288	350	288	350	429	534
19 m	170	211	211	253	308	253	308	378	470
21 m	140	174	174	209	254	209	254	311	387
23 m	113	140	140	168	205	168	205	251	312
25 m	86	107	107	128	156	128	156	191	238
27 m	60	75	75	89	109	89	109	133	166
29 m	43	53	53	64	78	64	78	96	119
31 m	27	34	34	40	49	40	49	60	75
33 m	15	19	19	22	27	22	27	33	41
35 m	9	11	11	13	16	13	16	20	25
TOTAL VOLUME	3985	3000	3000	3000	3000	3000	3000	3000	3000
		3000	3000	3000	3000	3000	3000	3000	3000
		3000	3000	3000	3000	3000	3000	3000	3000

EPI
META
HYPO

ZOOPLANKTON HAUL DEPTH
6 m
6 m
13 m
21 m
30 m

CHUB

VOLUME PUMPED IN mL

DEPTH	UNSTRATIFIED	STRATIFIED							
		A	B	C	D	E	F	G	H
1 m	611	3000	3000	1653	1653	1208	1208	990	861
3 m	498	3000	1647	1347	1347	984	984	807	701
5 m	409	642	1353	1651	1202	808	808	663	576
7 m	334	524	667	1349	981	3000	1637	541	470
9 m	278	436	555	713	817	713	1363	3000	392
11 m	256	402	511	657	862	657	862	862	3000
13 m	188	295	375	482	633	482	633	633	888
15 m	144	226	287	370	485	370	485	485	680
17 m	111	174	222	285	374	285	374	374	524
19 m	83	130	166	213	279	213	279	279	392
21 m	59	93	118	151	199	151	199	199	279
23 m	38	30	76	96	128	98	128	128	180
25 m	12	19	24	31	40	31	40	40	57
TOTAL VOLUME	3018	3000	3000	3000	3000	3000	3000	3000	3000
		3000	3000	3000	3000	3000	3000	3000	3000
		3000	3000	3000	3000	3000	3000	3000	3000

EPI
META
HYPO

ZOOPLANKTON HAUL DEPTH
4 m
4 m
9 m
15 m
20 m

CROSSON — VOLUME PUMPED IN mL

DEPTH	UNSTRATIFIED	STRATIFIED A	B	C	D	E	F	G
1 m	655	3000	1638	1638	1195	1195	983	983
3 m	545	1652	1363	1363	994	994	818	818
5 m	445	1348	1673	1234	812	812	668	668
7 m	353		1327	979	3000	1662	530	530
9 m	284			787		1338	3000	1658
11 m	230							1342
13 m	176							
15 m	129							
17 m	91							
19 m	56							
21 m	26							
23 m	9							
TOTAL VOLUME	2999	3000	3000	3000	3000	3000	3000	3000
		3000	3000	3000	3000	3000	3000	3000

EPI
META

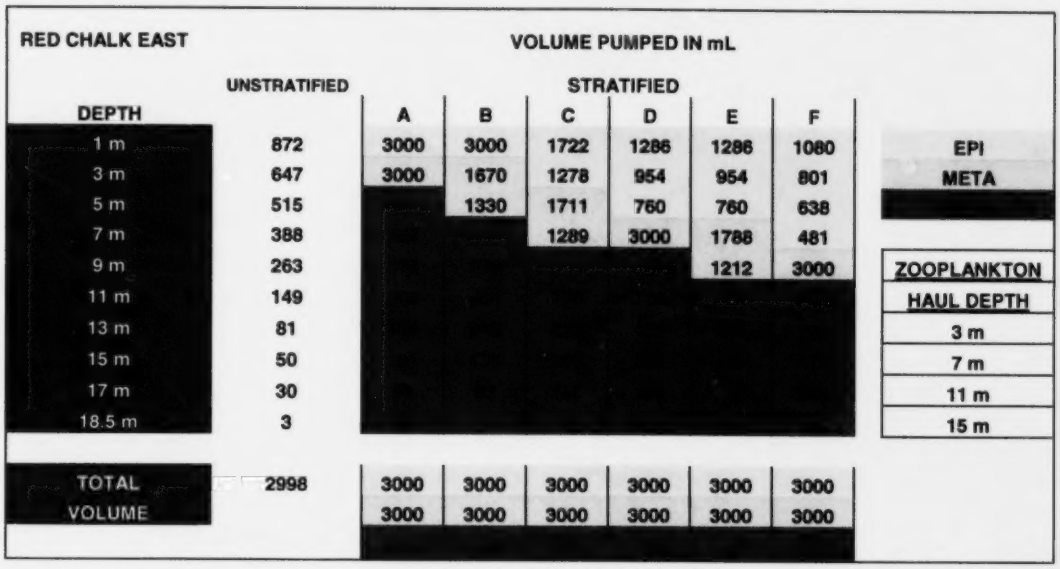
ZOOPLANKTON HAUL DEPTH
4 m
4 m
9 m
14 m
19 m

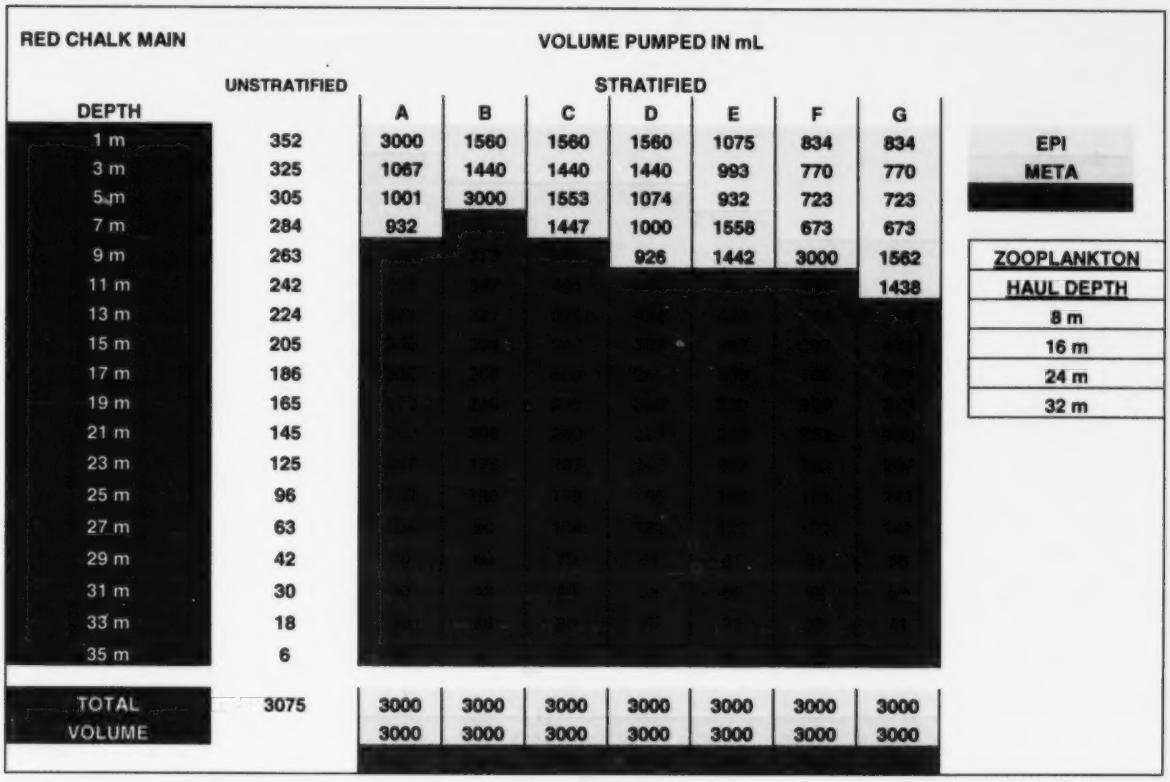
BLUE CHALK — VOLUME PUMPED IN mL

DEPTH	UNSTRATIFIED	STRATIFIED A	B	C	D	E	F	G
1 m	675	3000	1640	1640	1179	1179	967	846
3 m	560	3000	1360	1360	978	978	802	701
5 m	482		3000	1681	842	842	690	604
7 m	378			1319	1673	1242	541	473
9 m	300				1327	986	1682	376
11 m	235					772	1318	3000
13 m	200							
15 m	163							
17 m	107							
19 m	56							
21 m	6							
TOTAL VOLUME	3162	3000	3000	3000	3000	3000	3000	3000
		3000	3000	3000	3000	3000	3000	3000

EPI
META

ZOOPLANKTON HAUL DEPTH
4 m
4 m
9 m
15 m
20 m


RED CHALK EAST
VOLUME PUMPED IN mL
UNSTRATIFIED
STRATIFIED
DEPTH
A B C D E F
1 m 872 3000 3000 1722 1286 1286 1080
3 m 647 3000 1670 1278 954 954 801
5 m 515 1330 1711 760 760 638
7 m 388 1289 3000 1788 481
9 m 263 1212 3000
11 m 149
13 m 81
15 m 50
17 m 30
18.5 m 3
TOTAL VOLUME 2998 3000 3000 3000 3000 3000 3000
3000 3000 3000 3000 3000 3000
EPI
META
ZOOPLANKTON
HAUL DEPTH
3 m
7 m
11 m
15 m


RED CHALK MAIN
VOLUME PUMPED IN mL
UNSTRATIFIED
STRATIFIED
DEPTH
A B C D E F G
1 m 352 3000 1560 1560 1560 1075 834 834
3 m 325 1067 1440 1440 1440 993 770 770
5 m 305 1001 3000 1553 1074 932 723 723
7 m 284 932 1447 1000 1558 673 673
9 m 263 926 1442 3000 1562
11 m 242 1438
13 m 224
15 m 205
17 m 186
19 m 165
21 m 145
23 m 125
25 m 96
27 m 63
29 m 42
31 m 30
33 m 18
35 m 6
TOTAL VOLUME 3075 3000 3000 3000 3000 3000 3000 3000
3000 3000 3000 3000 3000 3000 3000
EPI
META
ZOOPLANKTON
HAUL DEPTH
8 m
16 m
24 m
32 m

CROSSON — VOLUME PUMPED IN mL

DEPTH	UNSTRATIFIED	STRATIFIED A	B	C	D	E	F	G
1 m	655	3000	1638	1638	1195	1195	983	983
3 m	545	1652	1363	1363	994	994	818	818
5 m	445	1348	1673	1234	812	812	668	668
7 m	353	782	1327	979	3000	1662	530	530
9 m	284	629	851	787	851	1338	3000	1658
11 m	230	510	689	962	689	962	962	1342
13 m	176	390	527	736	527	736	736	1064
15 m	129	286	387	540	387	550	540	795
17 m	91	202	273	381	273	381	381	561
19 m	56	124	168	234	168	234	234	345
21 m	26	58	78	109	78	109	109	160
23 m	9	20	27	38	27	38	38	55
TOTAL VOLUME	2999	3000	3000	3000	3000	3000	3000	3000
		3000	3000	3000	3000	3000	3000	3000
		3000	3000	3000	3000	3000	3000	3000

EPI
META
HYPO

ZOOPLANKTON HAUL DEPTH
4 m
4 m
9 m
14 m
19 m

BLUE CHALK — VOLUME PUMPED IN mL

DEPTH	UNSTRATIFIED	STRATIFIED A	B	C	D	E	F	G
1 m	675	3000	1640	1640	1179	1179	967	846
3 m	560	3000	1360	1360	978	978	802	701
5 m	482	750	3000	1681	842	842	690	604
7 m	378	588	785	1319	1673	1242	541	473
9 m	300	467	623	843	1327	986	1682	376
11 m	235	366	488	661	919	772	1318	3000
13 m	200	311	415	562	782	1128	1128	1128
15 m	163	254	338	458	638	919	919	919
17 m	107	167	222	301	419	603	603	603
19 m	56	87	116	157	229	316	316	316
21 m	6	9	12	17	23	34	34	34
TOTAL VOLUME	3162	3000	3000	3000	3000	3000	3000	3000
		3000	3000	3000	3000	3000	3000	3000
		3000	3000	3000	3000	3000	3000	3000

EPI
META
HYPO

ZOOPLANKTON HAUL DEPTH
4 m
4 m
9 m
15 m
20 m

RED CHALK EAST — VOLUME PUMPED IN mL

DEPTH	UNSTRATIFIED	STRATIFIED					
		A	B	C	D	E	F
1 m	872	3000	3000	1722	1286	1286	1080
3 m	647	3000	1670	1278	954	954	801
5 m	515	1045	1330	1711	760	760	638
7 m	388	787	1207	1289	3000	1788	481
9 m	263	533	818	1370	1370	1212	3000
11 m	149	302	464	776	776	1428	1428
13 m	81	164	252	422	422	776	776
15 m	50	101	156	260	260	479	479
17 m	30	61	93	156	156	288	288
18.5 m	3	6	9	16	16	29	29
TOTAL VOLUME	2998	3000	3000	3000	3000	3000	3000
		3000	3000	3000	3000	3000	3000
		3000	3000	3000	3000	3000	3000

EPI
META
HYPO

ZOOPLANKTON HAUL DEPTH
3 m
7 m
11 m
15 m

RED CHALK MAIN — VOLUME PUMPED IN mL

DEPTH	UNSTRATIFIED	STRATIFIED						
		A	B	C	D	E	F	G
1 m	352	3000	1560	1560	1560	1075	834	834
3 m	325	1067	1440	1440	1440	993	770	770
5 m	305	1001	3000	1553	1074	932	723	723
7 m	284	932	407	1447	1000	1558	673	673
9 m	263	436	377	436	926	1442	3000	1562
11 m	242	401	347	401	469	469	469	1438
13 m	224	371	321	371	434	434	434	515
15 m	205	340	294	340	397	397	397	471
17 m	186	308	266	308	360	360	360	427
19 m	165	273	236	273	320	320	320	379
21 m	145	240	208	240	283	283	283	335
23 m	125	207	179	207	242	242	242	287
25 m	96	159	138	159	186	186	186	221
27 m	63	104	90	104	122	122	122	145
29 m	42	70	60	70	81	81	81	96
31 m	30	50	43	50	58	58	58	69
33 m	18	30	26	30	35	35	35	41
35 m	6	10	9	10	12	12	12	14
TOTAL VOLUME	3075	3000	3000	3000	3000	3000	3000	3000
		3000	3000	3000	3000	3000	3000	3000
		3000	3000	3000	3000	3000	3000	3000

EPI
META
HYPO

ZOOPLANKTON HAUL DEPTH
8 m
16 m
24 m
32 m

RIDOUT		VOLUME PUMPED IN ml.				
	UNSTRATIFIED	STRATIFIED				
DEPTH		A	B	C	D	E
1m	748	3000	1720	1720	1272	1122
3m	558	1283	1283	1283	949	837
5m	463	1085	1736	1296	787	695
7m	338	777	1268	946	3000	507
9m	284			795		3000
11m	240					
13m	142					
15m	104					
17m	66					
19m	21					
TOTAL VOLUME	2964	3000	3003	3003	3007	3161
		3126	3004	3038	3000	3000

EPI
META

ZOOPLANKTON HAUL DEPTH'S
4
4
9
14
19

Form 2. Blank submission form

Date Submitted:

Sampled by:

SUBNUM

Form Type: Lakes

Sub Description: A Lakes

Client ID: 2 8 9 0 6

WHMIS

Program Code: 0 1 7 0 7 0 1

HEALTH 0

FLAMMABILITY 0

REACTIVITY 0

PROTECTION 0

POTENTIAL HAZARD HEALTH

FIELD SAMPLE IDS All

Client Contact

Name: Martyn Futter

Address: DESC, Bellwood Acres Rd, Dorset, P0A 1E0

Phone: 705-766-2030

LAB SAMPLE NUMBER	Field Samp#	Cont Sent	STATION	DATE dd/mm/yy	TIME hh:mm	LDESC	PARENT PRODUCT	PRODUCT
	1	5						
	2	1						
	3	5						
	4	1						
	5	5						
	6	1						
	7	5						
	8	1						
	9	5						
	10	1						
	11	5						
	12	1						

Form 3. Completed submission form

Date Submitted:	Oct. 9, 2002	Sampled by:	RI BG
Form Type:	Lakes	Sub Description	A Lakes
Client ID	2 8 9 0 6		WHMIS
Program Code	0 1 7 0 7 0 1		HEALTH 0
			FLAMMABILITY 0
			REACTIVITY 0
Client Contact Name:	Martyn Futter		PROTECTION 0
Address:	DESC, Bellwood Acres Rd, Dorset, P0A 1E0		POTENTIAL HAZARD HEALTH
Phone:	705-766-2030		FIELD SAMPLE IDS All

SUBNUM:

LAB SAMPLE NUMBER	Field Samp#	Cont Sent	STATION	DATE dd/mm/yy	TIME hh:mm	LDESC	PARENT PRODUCT	PRODUCT
C98912-0001	1	5	0 3 0 0 8 5 5 1 0 0 1	09-Oct-02	13:40	DE EPI	DRCLKA	MET 3386
C98912-0002	2	1	0 3 0 0 8 5 5 1 0 0 1	09-Oct-02	13:40	DE EPI		TP 3036
C98912-0003	3	5	0 3 0 0 8 5 5 1 0 0 1	09-Oct-02	13:40	DE META	DRCLKA	MET 3386
C98912-0004	4	1	0 3 0 0 8 5 5 1 0 0 1	09-Oct-02	13:40	DE META		TP 3036
C98912-0005	5	5	0 3 0 0 8 5 5 1 0 0 1	09-Oct-02	13:40	DE HYPO	DRCLKA	MET 3386
C98912-0006	6	1	0 3 0 0 8 5 5 1 0 0 1	09-Oct-02	13:40	DE HYPO		TP 3036
C98912-0007	7	1	0 3 0 0 8 5 5 1 0 0 1	09-Oct-02	13:40	DE EUPH	DRCCHLO	
C98912-0008	8	2	0 3 0 0 8 5 5 1 0 0 1	09-Oct-02	13:40	0.1		pH3042/CARB3028
C98912-0009	9	2	0 3 0 0 8 5 5 1 0 0 1	09-Oct-02	13:40	1		pH3042/CARB3028
C98912-0010	10	2	0 3 0 0 8 5 5 1 0 0 1	09-Oct-02	13:40	3		pH3042/CARB3028
C98912-0011	11	2	0 3 0 0 8 5 5 1 0 0 1	09-Oct-02	13:40	5		pH3042/CARB3028
C98912-0012	12	2	0 3 0 0 8 5 5 1 0 0 1	09-Oct-02	13:40	7		pH3042/CARB3028
C98912-0013	13	2	0 3 0 0 8 5 5 1 0 0 1	09-Oct-02	13:40	9		pH3042/CARB3028

RIDOUT		VOLUME PUMPED IN ml.				
	UNSTRATIFIED	STRATIFIED				
DEPTH		A	B	C	D	E
1m	748	3000	1720	1720	1272	1122
3m	558	1283	1283	1283	949	837
5m	463	1065	1736	1296	787	695
7m	338	777	1268	946	3000	507
9m	284	1079	1079	795	1079	3000
11m	240	912	912	1200	912	1200
13m	142	540	540	710	540	710
15m	104	395	395	520	395	520
17m	66	251	251	330	251	330
19m	21	80	80	105	80	105
TOTAL VOLUME	2964	3000	3003	3003	3007	3161
		3126	3004	3038	3000	3000
		3257	3257	2865	3257	2865

EPI
META
HYPO

ZOOPLANKTON
HAUL DEPTH'S
4
4
9
14
19

Form 2. Blank submission form

Date Submitted:
Sampled by:
Form Type: Lakes
Sub Description: A Lakes
Client ID: 2 8 9 0 6
WHMIS
Program Code: 0 1 7 0 7 0 1
HEALTH 0
FLAMMABILITY 0
REACTIVITY 0
PROTECTION 0
POTENTIAL HAZARD HEALTH
FIELD SAMPLE IDS All

Client Contact
Name: Martyn Futter
Address: DESC, Bellwood Acres Rd, Dorset, P0A 1E0
Phone: 705-766-2030

LAB SAMPLE NUMBER	Field Sample	Cont Sent	STATION	DATE dd/mm/yy	TIME hh:mm	LDESC	PARENT PRODUCT	PRODUCT
	1	5						
	2	1						
	3	5						
	4	1						
	5	5						
	6	1						
	7	5						
	8	1						
	9	5						
	10	1						
	11	5						
	12	1						

Form 3. Completed submission form

Date Submitted: Oct. 9, 2002	Sampled by: RI BG	SUBNUM:	
Form Type: Lakes	Sub Description A Lakes		
Client ID 2 8 9 0 6	WHMIS		
Program Code 0 1 7 0 7 0 1	HEALTH 0		
	FLAMMABILITY 0		
	REACTIVITY 0		
Client Contact	PROTECTION 0		
Name: Martyn Futter	POTENTIAL HAZARD	HEALTH	
Address: DESC, Bellwood Acres Rd, Dorset, P0A 1E0	FIELD SAMPLE IDS	All	
Phone: 705-766-2030			

LAB SAMPLE NUMBER	Field Samp#	Cont Sent	STATION	DATE dd/mm/yy	TIME hh:mm	LDESC	PARENT PRODUCT	PRODUCT
C98912-0001	1	5	0 3 0 0 8 5 5 1 0 0 1	09-Oct-02	13:40	DE EPI	DRCLKA	MET 3386
C98912-0002	2	1	0 3 0 0 8 5 5 1 0 0 1	09-Oct-02	13:40	DE EPI		TP 3036
C98912-0003	3	5	0 3 0 0 8 5 5 1 0 0 1	09-Oct-02	13:40	DE META	DRCLKA	MET 3386
C98912-0004	4	1	0 3 0 0 8 5 5 1 0 0 1	09-Oct-02	13:40	DE META		TP 3036
C98912-0005	5	5	0 3 0 0 8 5 5 1 0 0 1	09-Oct-02	13:40	DE HYPO	DRCLKA	MET 3386
C98912-0006	6	1	0 3 0 0 8 5 5 1 0 0 1	09-Oct-02	13:40	DE HYPO		TP 3036
C98912-0007	7	1	0 3 0 0 8 5 5 1 0 0 1	09-Oct-02	13:40	DE EUPH	DRCCHLO	
C98912-0008	8	2	0 3 0 0 8 5 5 1 0 0 1	09-Oct-02	13:40	0.1		pH3042/CARB3028
C98912-0009	9	2	0 3 0 0 8 5 5 1 0 0 1	09-Oct-02	13:40	1		pH3042/CARB3028
C98912-0010	10	2	0 3 0 0 8 5 5 1 0 0 1	09-Oct-02	13:40	3		pH3042/CARB3028
C98912-0011	11	2	0 3 0 0 8 5 5 1 0 0 1	09-Oct-02	13:40	5		pH3042/CARB3028
C98912-0012	12	2	0 3 0 0 8 5 5 1 0 0 1	09-Oct-02	13:40	7		pH3042/CARB3028
C98912-0013	13	2	0 3 0 0 8 5 5 1 0 0 1	09-Oct-02	13:40	9		pH3042/CARB3028

FIELD EQUIPMENT CHECKLIST

All equipment should be clean and in good repair. The equipment list is as follows:

- A cooler containing 40 metres of 1/2" I.D. calibrated hose in one 25 metre length and one 15 metre length, a PET jar containing vinyl, powder-free gloves, a funnel with a 80 µm filter, a one liter graduated cylinder and 4, four liter Nalgene jugs for collection of epilimnetic, metalimnetic and hypolimnetic water and for phytoplankton / chlorophyll sample collection and a set of lake specific volume weighting charts for water sample collection and zooplankton haul depths.
- A second cooler containing frozen freezer packs for sample storage
- A Secchi disc with 15 metres of calibrated rope (Appendix 1)
- A peristaltic pump and charged battery (Appendix 1)
- A composite sampler with 7 metres of rope (spring only) (Appendix 1)
- A complete zooplankton net with cod end and 50 metre calibrated rope (Appendix 1)
- The Li-1400 light meter with metered cable and sensors
- The YSI model 58 (or model 95) oxygen / temperature meter with cable (Appendix 1)
- A complete set of carefully labeled sample vials for each lake (Appendix 1) including: one PET jar for phytoplankton, one PET jar for zooplankton, one 1-L square brown bottle for chlorophyll *a* and for each stratum: one 500-mL PET jar, one 100-mL yellow cap, one 250-mL brown pH / alkalinity bottle with gas cap, one 50-mL glass DIC tube with gas cap, two 50-mL etched (at 35mL) glass phosphorus tubes with Nalgene caps and for Harp, Plastic and Dickie lakes a set of DIC tubes with gas caps and pH bottles with gas caps for 0.1, 1, 3 metres, etc. to bottom
- A brown alkalinity bottle containing Lugol's (for recipe see Appendix 2) and a 1-mL eye dropper
- A PET jar containing 500 mL 4% sugar formalin (for recipe see Appendix 3)
- Other equipment and vials as necessary
- 2 paddles
- One life jacket per person
- A 20 lb. anchor with 50 m of rope
- A weatherproof field book with pencils and markers
- A safety kit including: floating rope, a whistle, flash light and a bailing bucket
- Topographic maps, lake bathymetry maps and information on lake access points and parking areas and if required field collection permits
- Rain gear and extra clothing
- Satellite phone when sampling remote locations
- Bright orange cones to place at either end of the truck when parking on the shoulder of the road while sampling
- Bug repellent and / or a bug jacket (seasonal)
- Survival kit (when sampling remote areas)